The Depressor Nerve of the Rabbit.

By B. B. Sarkar.

(Communicated by Sir E. Sharpey Schafer, F.R.S. Received October 31, 1921.)

(From the Department of Physiology, Edinburgh University.)

[Plate 4.]

Since the discovery of the depressor nerve,* much work has been done in connexion with its important influence on the regulation of blood-pressure, but (so far as I am aware) no attempt has been made to determine its histological structure.

Origin and Course of the Depressor.

Cyon† gives the following description of the origin of the nerve. The depressor nerve in the animals worked upon usually begins with two branches at the point of departure of the superior laryngeal nerve from the vagus, one from each of the two nerves. The nerve soon after its origin passes towards the cervical sympathetic, in company with which it descends the neck towards the inferior cervical ganglion. With this ganglion it is often connected by fine branches : it then turns inward past the subclavian artery, and loses itself at the base of the heart, to which it passes from behind between the pulmonary artery and the aorta. Just before entering the heart tissue the two depressors lie close to one another.

This is stated by Cyon to represent the course of the nerve in rabbits, cats, and horses, and probably in other mammals in which the cervical sympathetic runs separately from the vagus.

My own observations have been made upon rabbits. I have not been able to substantiate the statement that a separate depressor is present in the cat, and I have had no opportunity of investigating the subject in horses.

Besides making a number of sporadic observations on animals killed for different purposes, I have examined the depressor systematically on both sides in seven rabbits. I find that it varies greatly in its mode of origin, which is usually, as stated by Ludwig and Cyon, from two branches, one from the vagus, the other from the superior laryngeal (fig. 1). But in some cases it was a single nerve throughout (fig. 2), while in others the two branches of origin ran separately for a greater or less distance, and even to their destination (fig. 3).‡ When single the nerve was generally found to originate from the angle where the superior laryngeal leaves the vagus. When the two branches of origin were separate, one usually left the vagus at this point, but sometimes lower down, the other was derived from the superior laryngeal a short distance after it had left the vagus. In certain cases the whole nerve ran along the superior laryngeal for a little distance before emerging as a separate nerve. As Ludwig and Cyon state, the depressor lies close to the cervical sympathetic throughout most of its course: in the lower part of the neck one or two short branches unite it with the inferior cervical ganglion. I have usually found it to divide at its lower end into three filaments, one of which passes to the aorta and the other two to the base of the heart. In two instances in which the two branches of origin were quite separate throughout, one branch (the vagal) ran to the aorta without forming any connexion with the inferior cervical ganglion,* while the

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* Ludwig and Cyon, Arbeit. physiol. Anstalt, Leipzig, 1866.

† 'Methodik d. physiol. Experimente,' 1876.

‡ Figs. 1, 2, and 3, are merely diagrams, and are not intended to represent the actual size, distance apart, or length of the nerves.

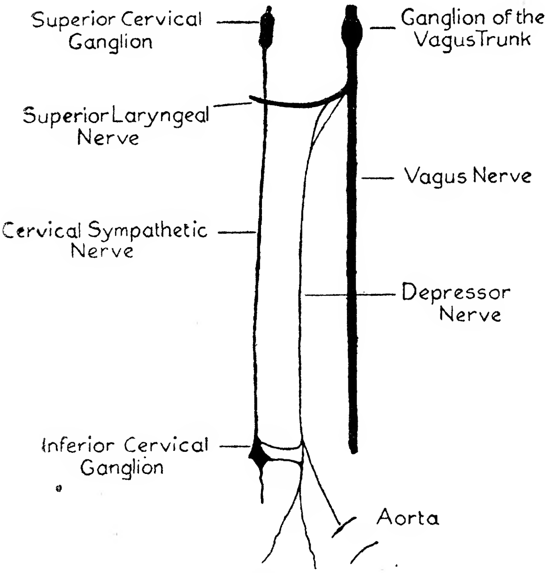
Superior Cervical Ganglion
Ganglion of the Vagus Trunk
Superior Laryngeal Nerve
Vagus Nerve
Cervical Sympathetic Nerve
Depressor Nerve
Inferior Cervical Ganglion
Aorta

FIG. 1.

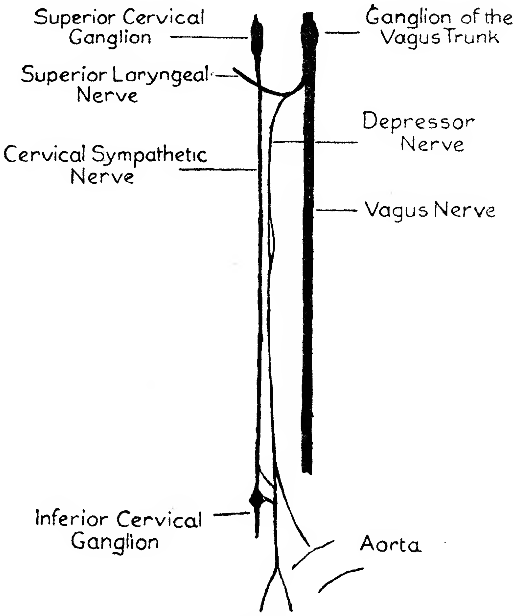
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FIG. 2.

FIG. 1.—Diagram of origin and course of depressor nerve in a rabbit, showing the usual derivation of the nerve by two threads, one from the superior laryngeal and the other from the vagus trunk.

FIG. 2.—Diagram showing the nerve originating as a single filament from the superior laryngeal. Note the (unusual) splitting and rejoining of the nerve in the middle of its course.

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* This ganglion, which has always been known to physiologists as the "inferior cervical," is now frequently termed by anatomists the "middle cervical."

other (the superior laryngeal) was connected by two filaments with that ganglion and then passed to the tissue at the base of the heart (fig. 3).

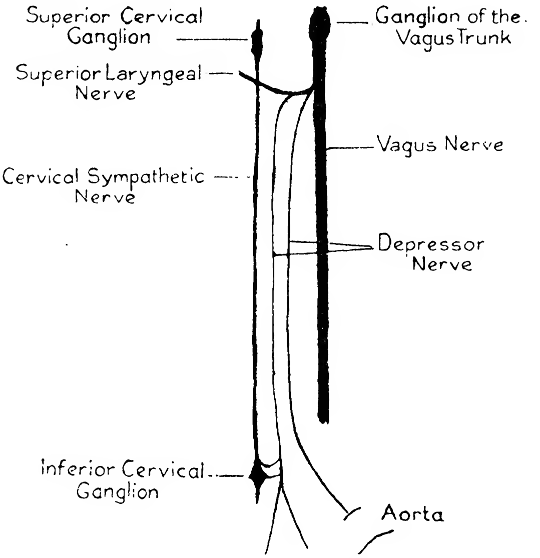
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Fig. 3.—Diagram showing the depressor passing down as two separate nerves, one of which, arising from the superior laryngeal, goes to the aorta; the other, arising from the vagus trunk, to the base of the heart. The first one is connected with the inferior cervical ganglion by two fine filaments. (These are also shown in figs. 1 and 2.)

To determine the exact origin of the nerve, serial sections of the vagus were made upwards from the angle where the superior laryngeal and the depressor leave it. All three nerves are encased in a single epineurium until the superior laryngeal separates from the vagus (fig. 6—see Plate 4). On examining such a series of sections a group of ganglion cells is found lying between the superior laryngeal and the main vagus trunk just before the superior laryngeal separates out (fig. 4). In some animals these cells are continued into the beginning of the superior laryngeal nerve as far as the point where its depressor branch leaves that nerve. When the whole depressor or one of its parts separates from the vagus after the superior laryngeal branch has been given off, the group of ganglion cells in question extends down the vagus trunk nearly as far as the point where its depressor branch emerges (fig. 5). These cells probably give origin to afferent fibres of the depressor. In cases in which the depressor emerges high up, the group may lie close below the ganglion trunci, although distinctly separate from that ganglion.

Microscopic Examination of the Nerve.

For histological purposes a piece of the nerve was slightly stretched on a card, fixed with osmic acid, washed and transferred to alcohol. Sections were cut by the paraffin method (figs. 7 and 8). Teased preparations were also examined. Microscopically, the nerve is found to consist of both myelinated and non-myelinated fibres (fig. 9). The myelinated fibres are both medium-sized and very fine. Most are between 4μ and 6μ (0·004–0·006 mm.) in diameter, but in two nerves two or three fibres of about 8μ (0·008 mm.) were found. The fine myelinated fibres have the character of pre-ganglionic autonomic nerves. The non-myelinated resemble post-ganglionic autonomic fibres. Both these kinds of fibres are presumably efferent.

The size of the whole nerve varies in different cases. The right nerve is usually smaller than the left and contains fewer myelinated fibres. I have made an attempt to count the myelinated fibres in six rabbits, but the small diameter of the finest fibres renders the task a difficult one. And it is impossible to see the non-myelinated fibres clearly enough in section to be able to count them. Nor is it easy to obtain sections so exactly transverse as to show each myelinated fibre distinctly. The following figures are therefore given for what they are worth:—

The total number of myelinated fibres of all sizes in the nerves of the two sides showed an individual difference of from 375 to 496 fibres, the average number being 433 in the two. The average number of myelinated fibres of all sizes in the right nerve was 177 and in the left 256. The total number of fibres contained in the branches when these remained separate fell within these limits.

Summary.

1. The depressor nerve of the rabbit appears to be connected, at least in part, with a special collection of ganglion-cells in the vagus, distinct from the ganglion of the trunk. This collection may extend a certain distance into the superior laryngeal, or may pass into the vagus trunk some distance below the ganglion of the trunk, but in most it lies in close contiguity with and just below that ganglion. The cells of the group in question probably give rise to the afferent fibres of the depressor.

The exact point of origin of the nerve is variable. It is usually formed by two branches, one from the superior laryngeal and one from the vagus. In some cases it is double throughout, in others single. It is connected below by fine branches with the inferior cervical ganglion, and can be traced to the root of the aorta and base of the heart.

2. The size of the nerve and the number of fibres it contains vary in different individuals. The left nerve is generally larger and contains more fibres than the right.

3. The depressor contains not only medium-sized myelinated fibres, but also a considerable number of very fine myelinated fibres, and others which are non-myelinated. It is, therefore, probably not wholly formed, as has usually been supposed, of afferent fibres, for these fine myelinated and non-myelinated fibres closely resemble those belonging to the autonomic nervous system and are presumably efferent.*

The expenses of this investigation have been mainly defrayed by a grant from the Earl of Moray Fund for promoting Research in the University of Edinburgh.

DESCRIPTION OF PLATE.

Fig. 4.—Section of vagus trunk just before the superior laryngeal branch is given off. On the left is seen the vagus; on the right, the superior laryngeal; between them the group of cells from which the afferent fibres of the depressor probably arise. Photograph × 75 diameters. Osmic preparation.

Fig. 5.—Section from the same preparation but taken a little lower down. The superior laryngeal is now quite separate from the vagus. The group of cells shown in fig. 4 is still visible, and fibres of the depressor are beginning to accumulate at the side of the vagus. Photograph × 75 diameters.

Fig. 6.—Section from the same preparation still lower down. The three nerves now appear as entirely distinct bundles, each surrounded with its own perineurium, but enclosed in a common epineurium. On the left, the vagus; on the right the superior laryngeal; the depressor is the small bundle of fibres between them. Photograph × 75 diameters.

Fig. 7.—Section of a depressor nerve. Osmic preparation. Photograph × 400 diameters.

Fig. 8.—Section of the two filaments of origin of a depressor nerve, just before their union. Photograph × 400 diameters. (This section is not from the same animal as that from which fig. 7 was obtained.)

Fig. 9.—From a teased osmic preparation of a depressor nerve. Photograph × 300 diameters. The figure shows medium-sized and fine myelinated fibres and a few non-myelinated fibres.

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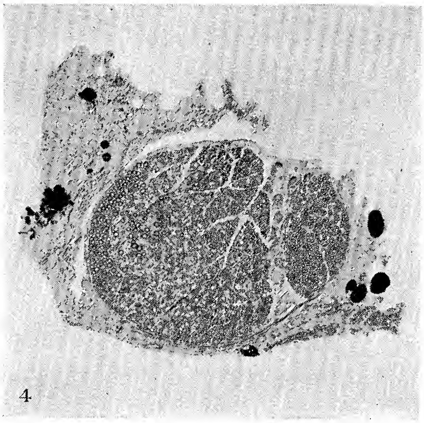
* According, however, to S. W. Ranson ('Physiological Review,' vol. 1, p. 479) small myelinated and unmyelinated fibres are included among visceral afferent fibres. This statement is based on his own observations recorded in 'Journ. Comp. Neurology,' vol. 29. See also the same Journal, vol. 24. (Private communication to E. S. S.)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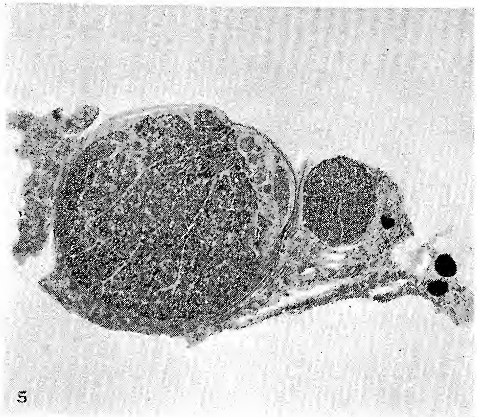
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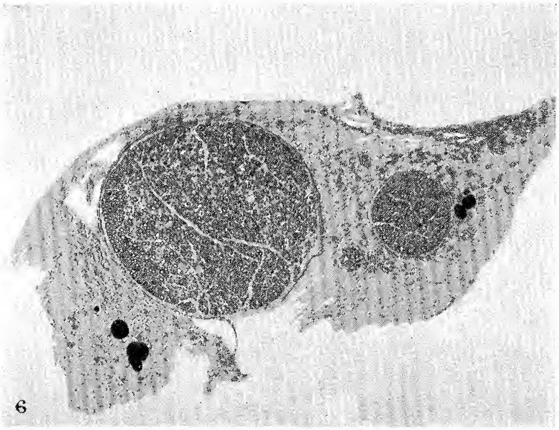
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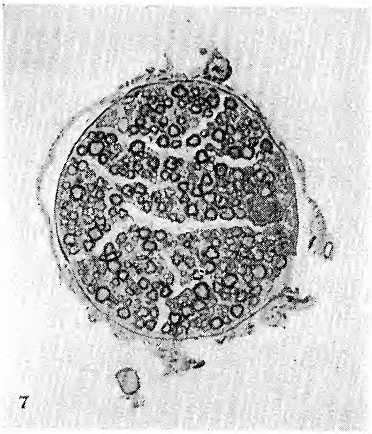
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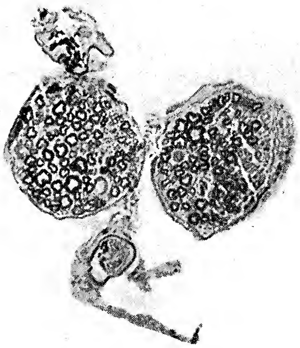
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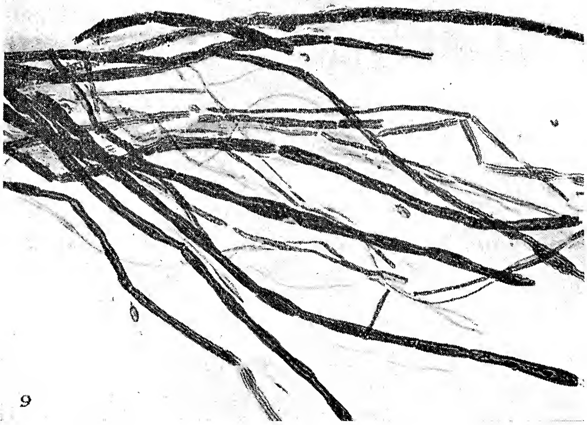
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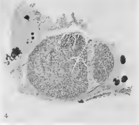

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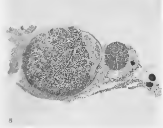

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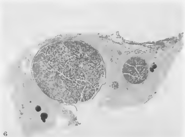

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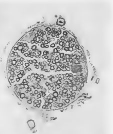

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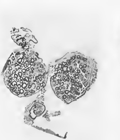

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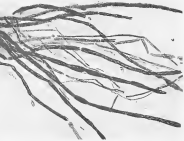

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